

Topographic Visualization and Geomorphometric Applications for Tectonic Analyses

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Topographic evidence has always been an important component of tectonic investigations. With new desktop computing capabilities and the growing availability of high resolution digital elevation models (DEMs), detailed topographic analyses are now practical even on regional scales. We are exploring the use of DEMs for tectonic visualizations and geomorphometric applications.

Essentially all information contained in a DEM can be perceived in a single image when the data are shaded and projected into stereo pairs or anaglyphs. A simple 3x3 box filter that calculates a north-dipping gradient (e.g., weights -1 -2 -1, 0 0 0, 1 2 1, with an offset of 1/28) 'shades' the relief. Left-eye and right-eye views are then calculated by displacing pixels right (east) and left (west), respectively, as a linear function of elevation. Vertical exaggerations are highly beneficial and are made by scaling the displacements. By replacing the shaded relief with an aerial or satellite image, perception of the terrain and its spectral features increases synergistically. With more-complex algorithms, such visualizations can be used in three-dimensional palinspastic reconstructions by observing the rotation, uplift, tilting, and translation that best matches features across faults.

We are also studying the theoretical limits of detecting subresolution changes in topography through time. Similar studies using satellite images show that precision varies with spatial resolution, radiometric quantization, and variance, and that detection of terrain shifts as small as 1/20 of a pixel should be possible. Analogous parameters should constrain subresolution measurements in DEMs.